



Linkage Standard Matters: Using Hospital Discharge Records to Develop Statewide Inpatient Master Index



Wu Xu¹, PhD, Zhiwei Liu¹, MS, Lawrence J Cook², PhD
Utah Department of Health¹ and University of Utah², Salt Lake City, UT

Introduction

- Variation of linkage quality could affect variation of measured outcomes.
- Standardized linkage methods will provide comparable assessment for linkage-based measures among different studies.
- This study developed a standard linkage method for Utah Department of Health (UDOH) to generate statewide inpatient master index for ongoing linkage projects.

Data, Linkage Elements, & Method

- 290,537 hospital inpatient discharge records from all hospitals in Utah from 12/01/2004 to 12/31/2005.
- Available linkage elements and each of their missing values were birth date (0% missing), gender (0%), first name (63%), hospital county (0%), hospital medical record number (0.8 %), middle name/initial (80%), last name (58%), social security number (SSN) (15.5 %), and zip code (0.1%).
- LinkSolv 7.0 used for de-duplication.
- Both deterministic and probabilistic methods are used.
- After the data were passed all nine separate matching processes, person-level records were merged through a function in the LinkSolv.

Standard Linkage Model for Utah Hospital Discharge Database

Pass.	Joint/Blocking Element (% of duplicates identified)	Match Element (Weight Adjustment)
Deterministic method		
1	Hospital ID, Medical Chart Number (23%)	Hospital ID (1.0) Medical Chart Number (1.0) Birth Year (1.0)
2	SSN, Birthday (39%)	SSN (1.0)
3	SSN, First Name (0.6%)	Birthday (1.0) First Name (1.0)
Probabilistic method		
4	Birth Month/Day, First Name's Initial, Zip Code (1%)	Birth Day (0.6)
5	Last Name, Birth Year, Hospital County (3%)	Zip Code (0.6)
6	Last Name Soundex, Birth Year, Hospital County (2%)	First Name (0.7)
7	SSN_Last 4 Digit, Birth Month/Day (1%)	Last Name (0.7)
8	Payer, Birth Day (6%)	First Name Soundex (0.5)
9	SSN_First 3 Digit, Birthday (25%)	Last Name Soundex (0.5)
		Hospital County (0.6)
		Gender (0.9)

Results

Inpatient Master Index was created for 238,490 individuals.

Hospital-to-hospital transfer rate for Utah within the study period was 3.1% (n=7,460).

Readmission rate was 18.7% (n=44,637). Approximately 78% of multiple hospitalizations occurred within the same hospital.

Impact of Missingness:

- **Missingness limits the de-duplication within hospitals:** About 6% of discharge records had neither SSN nor names. Most of these records were only de-duplicated within the same hospital by hospital medical chart number (Pass 1). Only 29 duplicates were found by Pass 8, requiring payer and birthday to agree.
- **Higher missingness, lower outcome rates:** The distribution of SSN missingness was examined by age, gender, hospital, and payer categories. The more often SSN was missing, the lower multiple hospitalization rates in certain population. For example, the newborn group had the highest SSN missing rate (39%) and lowest multiple hospitalization rate (2%). One hospital did not report any SSN for all of their patients; this hospital's multiple hospitalization rate was 0.0%.

Validation

- Linkage quality was manually validated by 28 inpatients with a code as "Discharge Status = 2 (transfer to another acute care hospitals)" in the index hospitalization
- All 35 pairs of hospitalizations are correctly linked by the standard model.
- Transfer code in the admission source for the second hospitalization is not a reliable validation criterion. Admission source for half of the transfers was coded as "Physician referral."

Conclusion

- Use both deterministic and probabilistic linkage methods to maximize linkage results and establish an efficient operational linkage system.
- Poor data quality may lead to incorrect linkage or missed multiple hospitalizations possibly causing incorrect estimates of outcome measures.
- Inconsistent linkage methods could contribute to outcome variations.

Acknowledgements

This study is supported by CDC Grant No. P01 CD000284-01, P.I. Matthew Samore, Utah Research Center for Excellence in Public Health Informatics, and Utah Office of Health Care Statistics.

Contact Information

Wu Xu, wxu@utah.gov (801) 538-7072